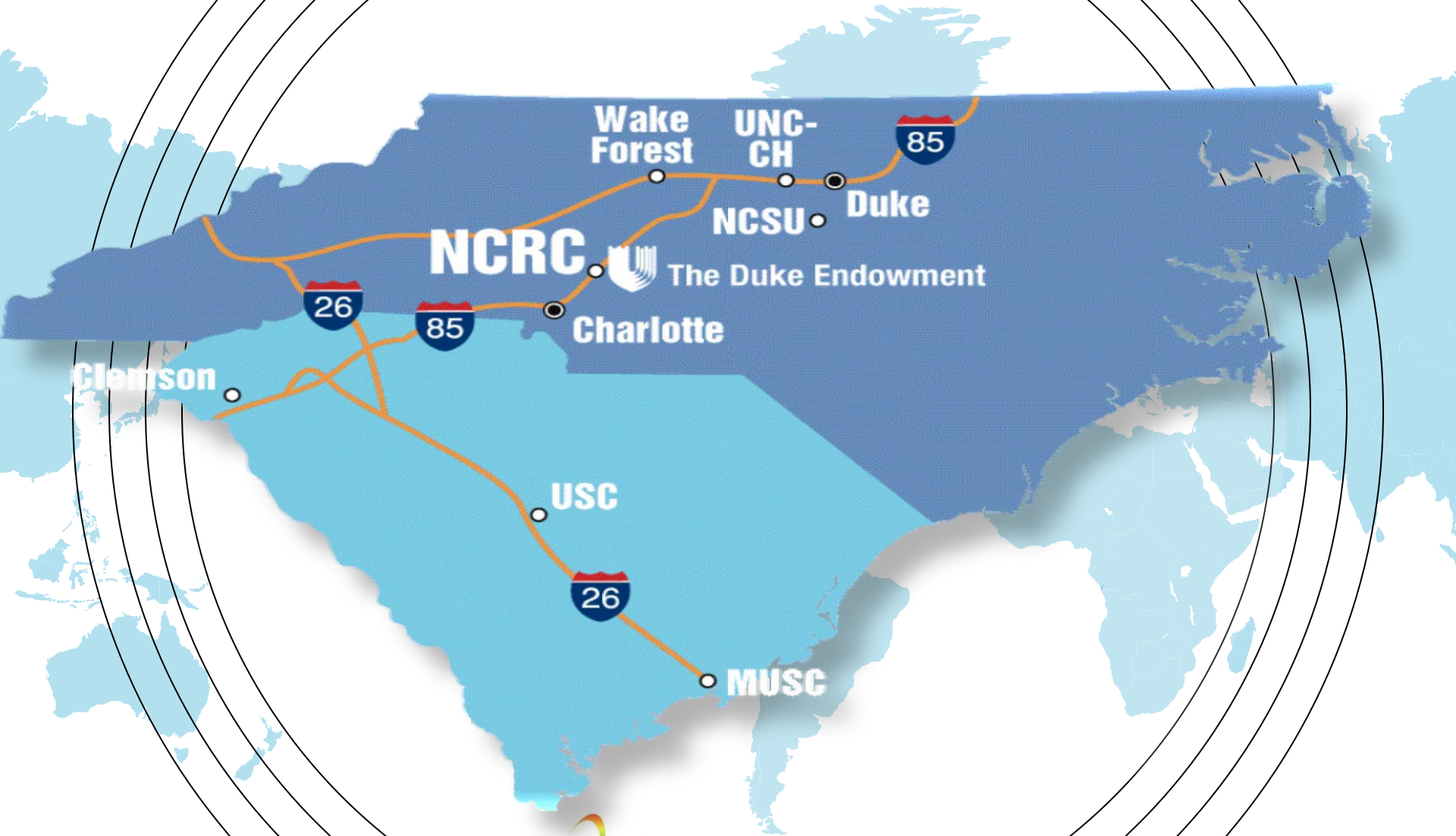


SUPERFRUITS IN THE HEALTH/SCIENCE SPOTLIGHT



NCRC- near Charlotte, NC, east coast USA



Leading discovery and delivery of
innovative plant-based solutions to
advance human health & wellness

NC STATE UNIVERSITY

Plants for Human Health



I N S T I T U T E

1. Whole Foods
3. Dietary supplements
5. Phytopharmaceuticals

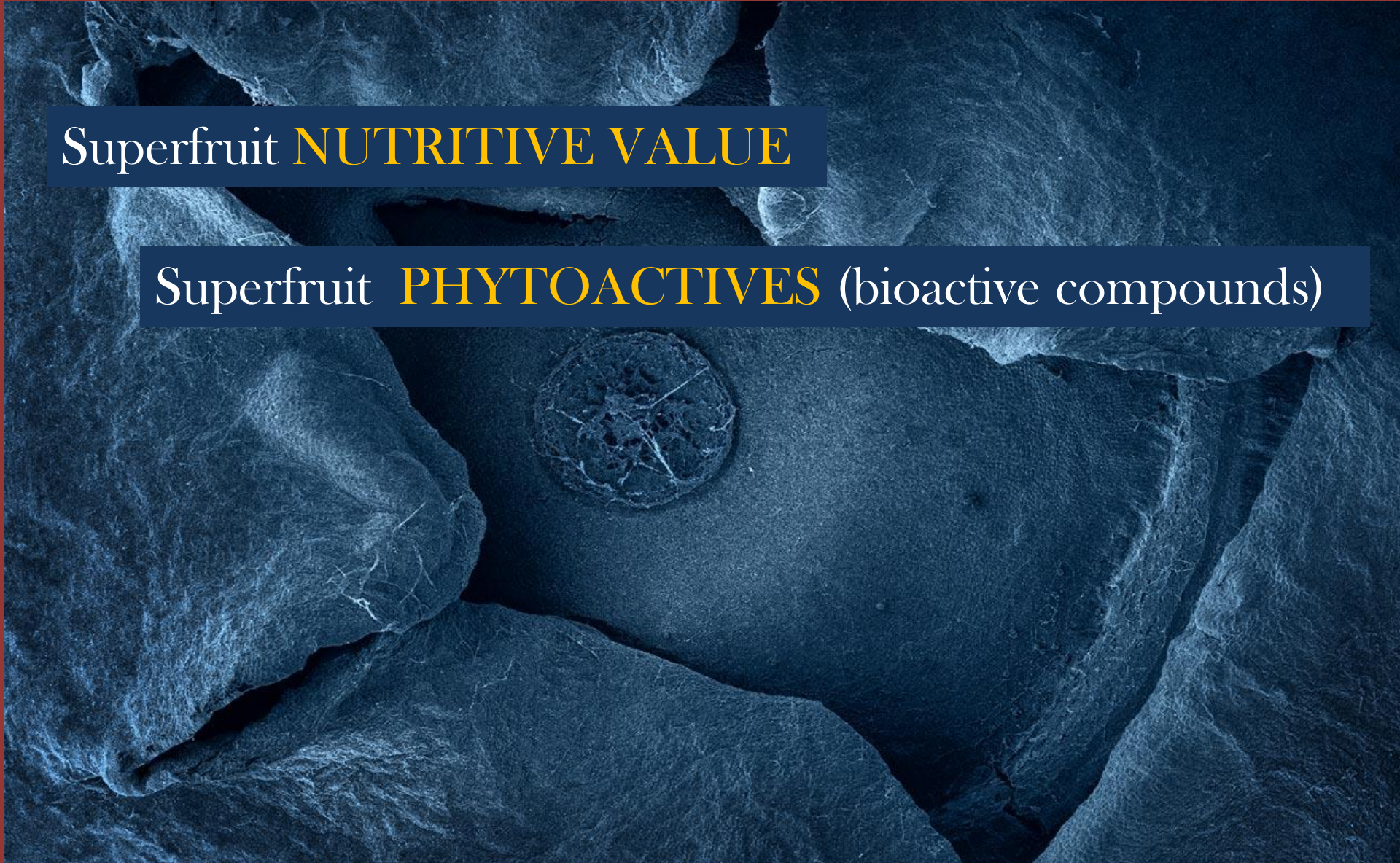
2. Functional foods
4. Medical foods



Characteristics of a Superfruit

Superfruit **NUTRITIVE VALUE**

Superfruit **PHYTOACTIVES** (bioactive compounds)



Bioactive phytochemicals a.k.a. *phytoactives*: natural compounds in fruits vegetables nuts and grains which positively impact on human health



Fruits & Berries
Vegetables



Nuts



Tea



Cocoa

Coffee





Origin of Superfruits & their Phytoactives| “Stressed for Success”



DNA-protective antiviral antimicrobial

antiadhesin free-radical scavenging

ADD-therapeutic UTI-inhibition

antidiabetic cancer-chemopreventive

SUPERFRUITS

cardioprotective

anti-osteoporosis

neuroprotective

estrogen antagonism

enzyme activating/inhibiting

antiproliferative

iron chelating

neuronal signaling

antioxidant

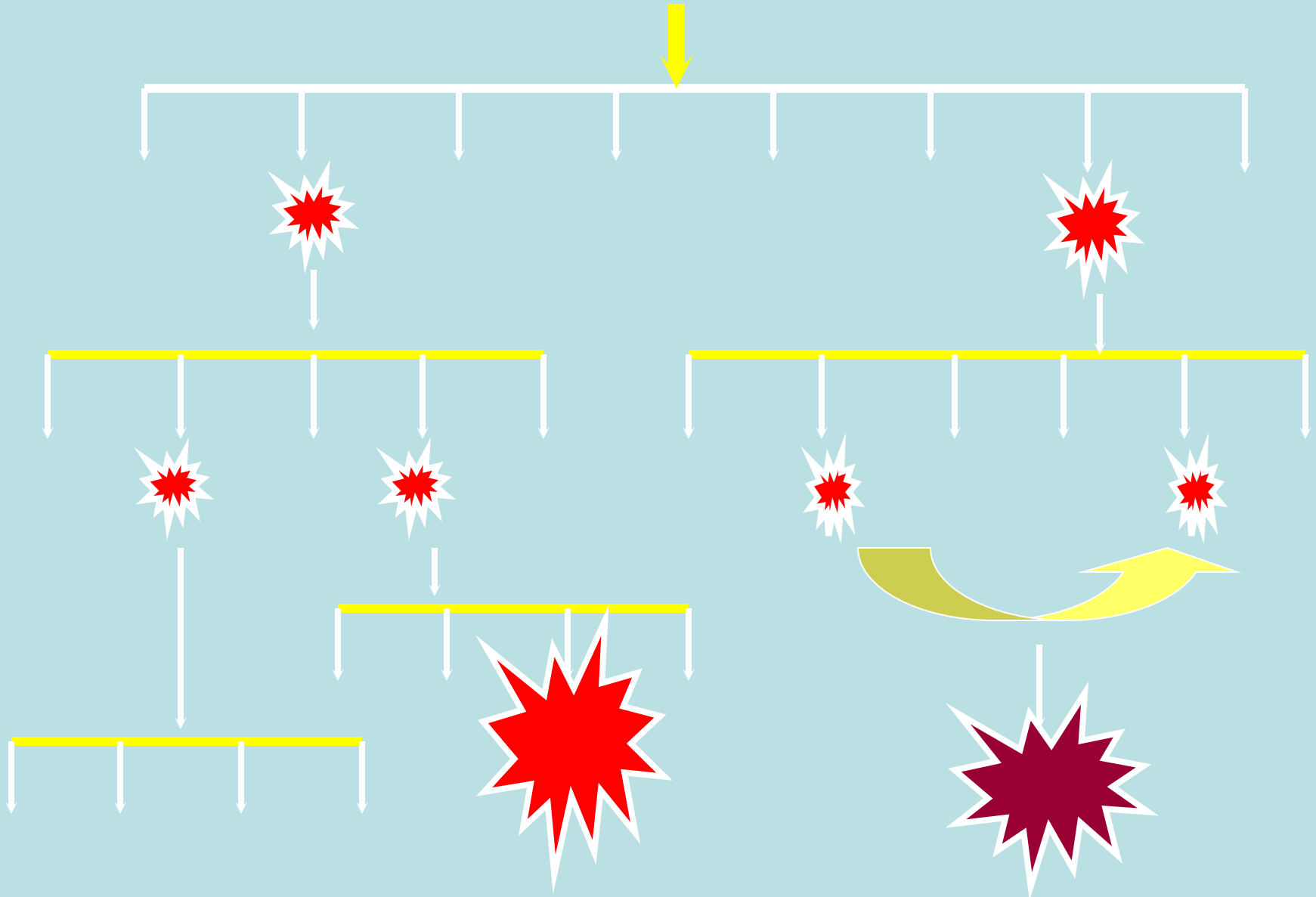
membrane-modulating

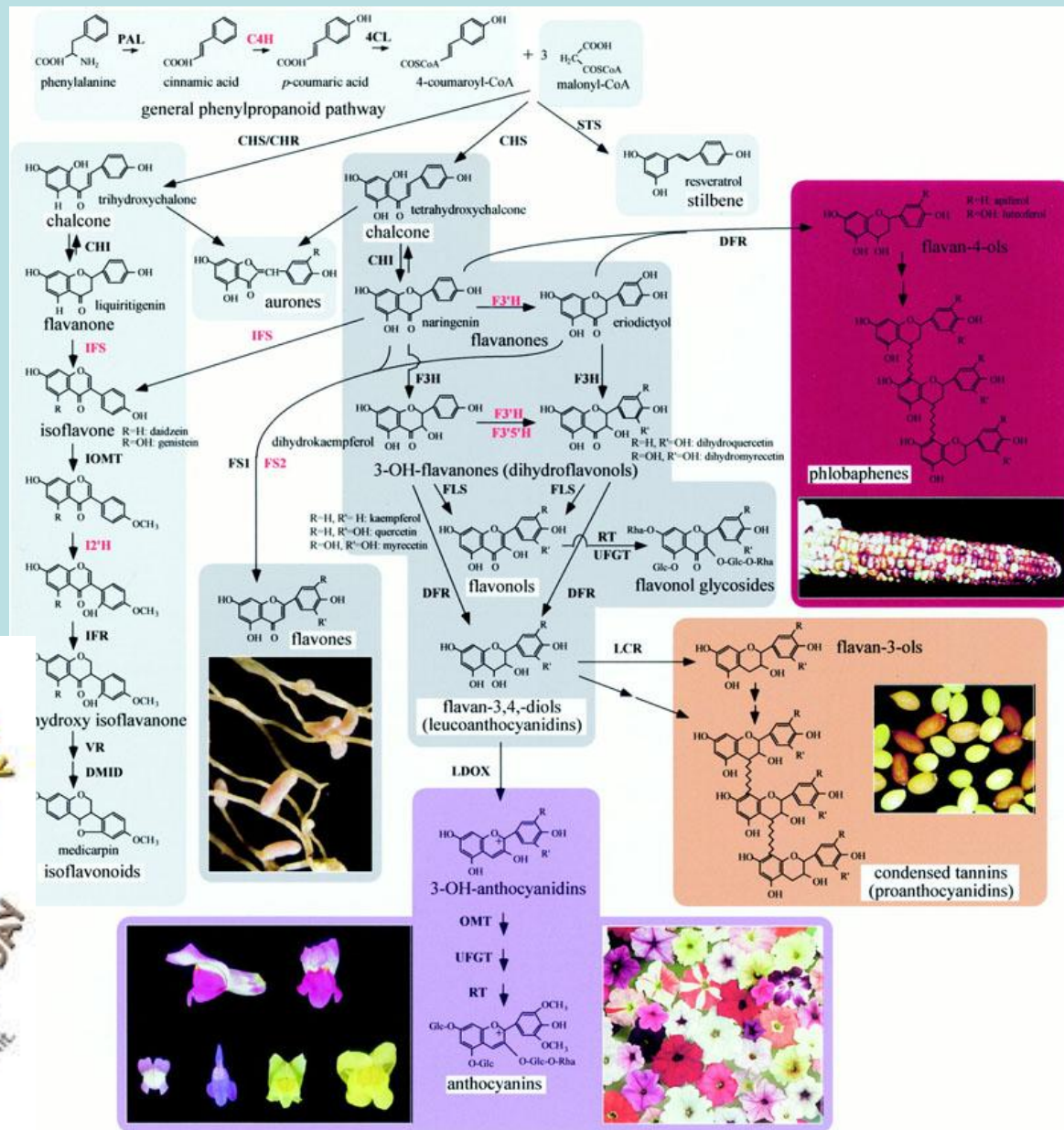
anti-inflammatory



Interacting mixtures
Breakdown metabolites
Multiplicity of bioactivities
Difficult to pinpoint bioavailability

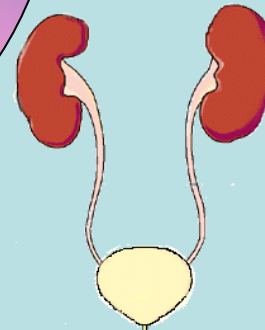
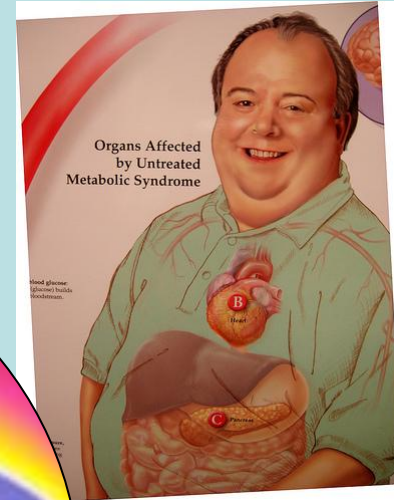
Phytoactives in a FRUIT extract



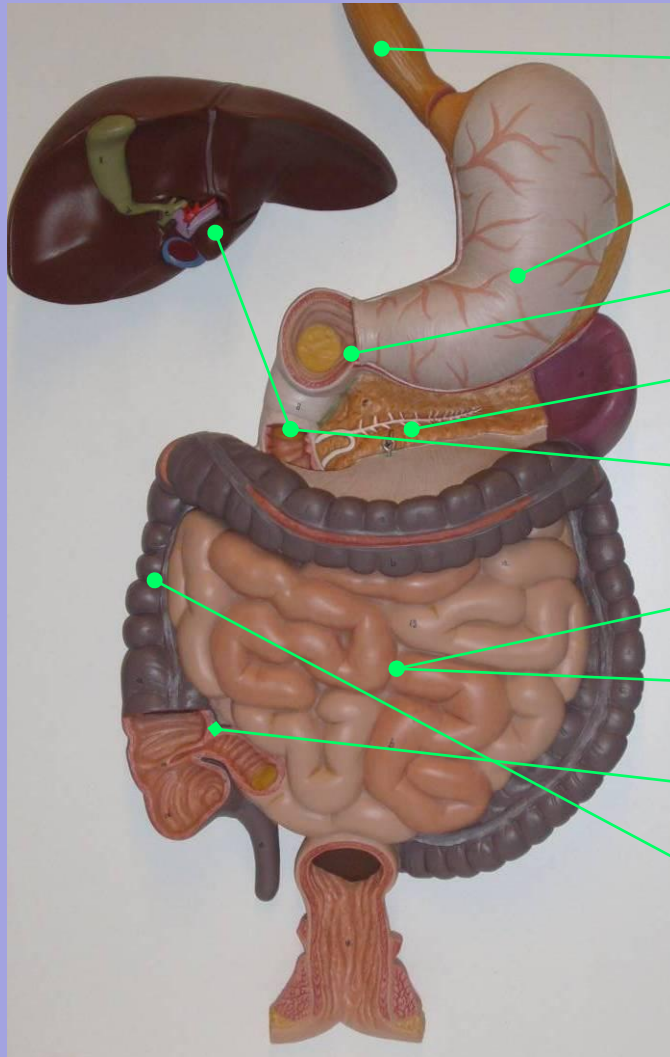


Multiplicity of bioactivities

<http://www.thespoof.com/news/spoof.cfm?headline=s5i82852>



GI Tract Features Successive Dynamic Conditions



Swallow

Gastric

Gastric

Secretion

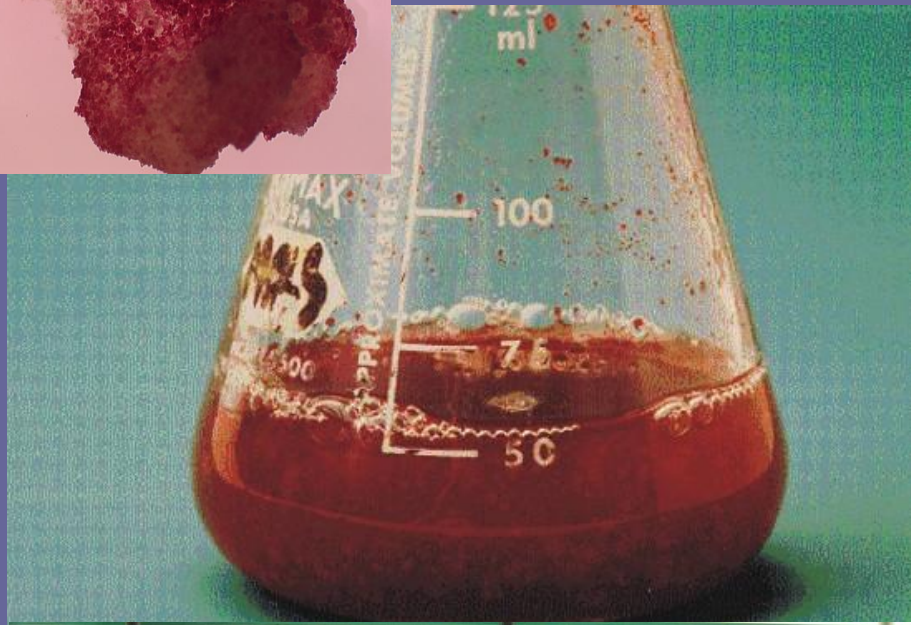
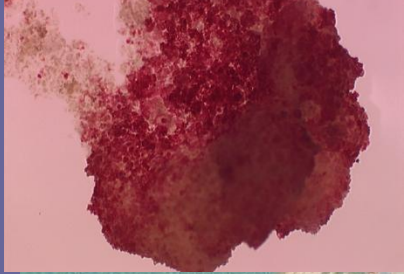
Bile secretion

Peristalsis



Water

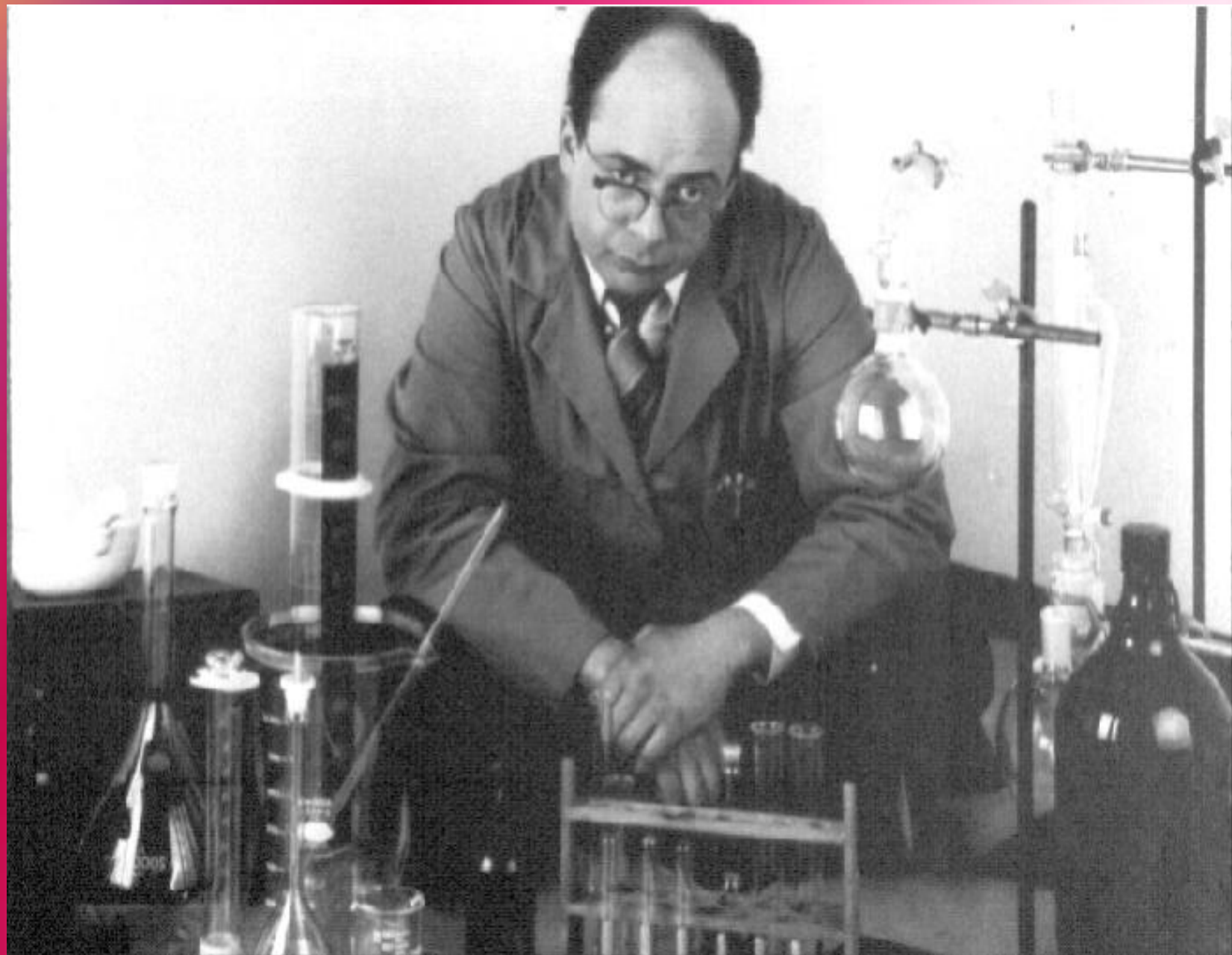




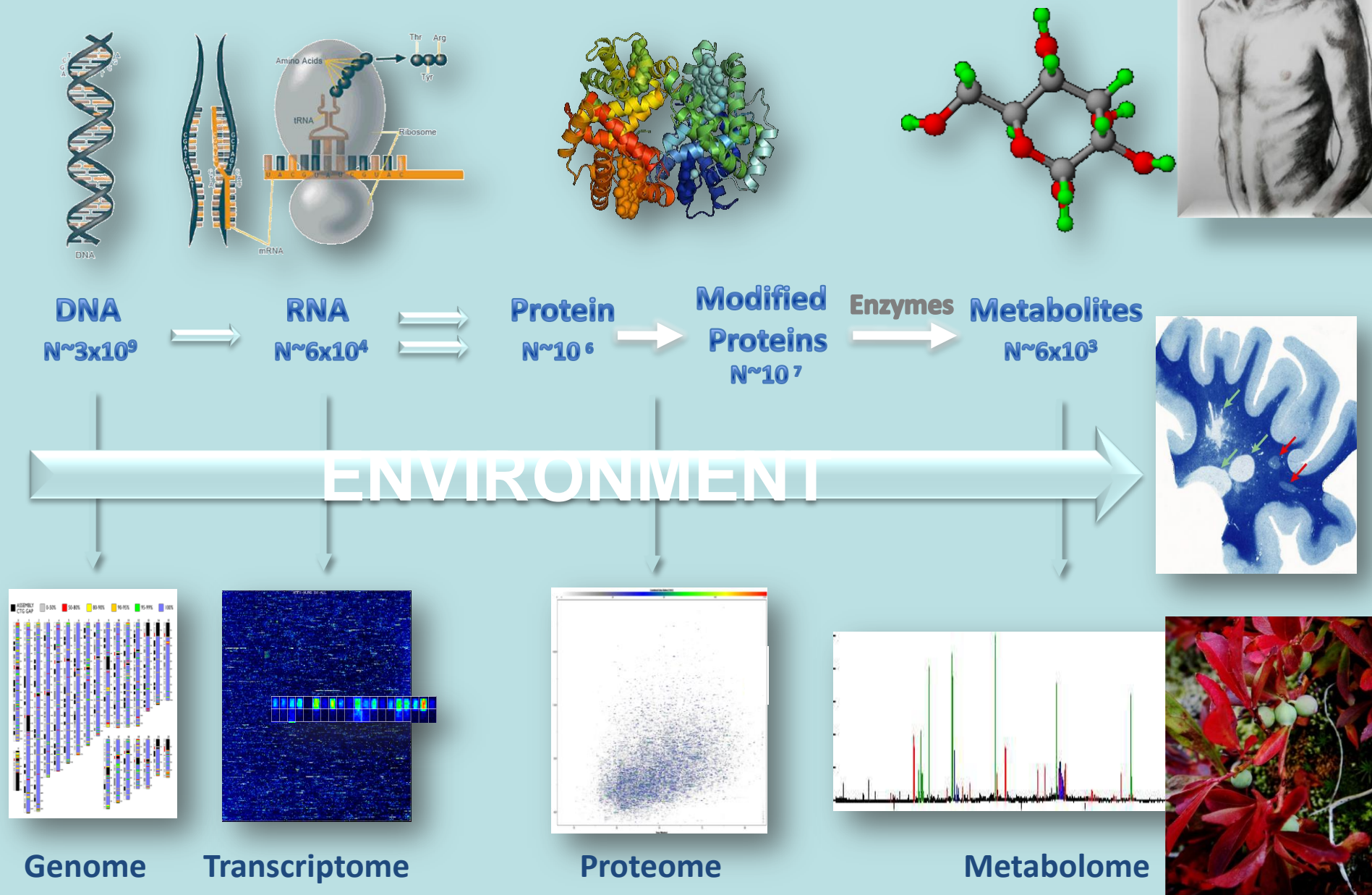
Ja
J M

Ja
Nu
Re





'omics Strategies to Pinpoint the Health Benefits of Superfruits



Superfruits Scrutinized | Genomics & Metabolomics

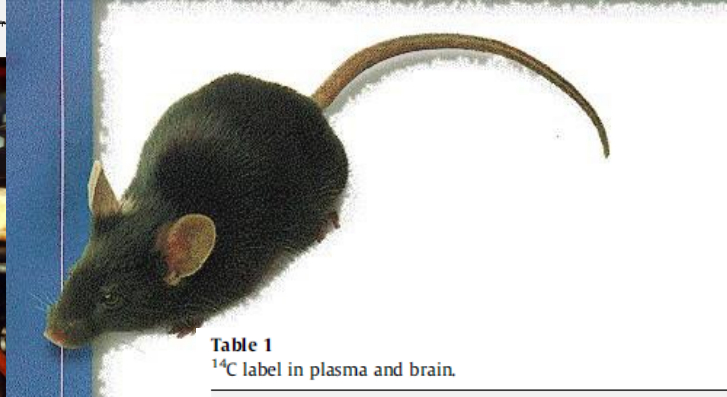
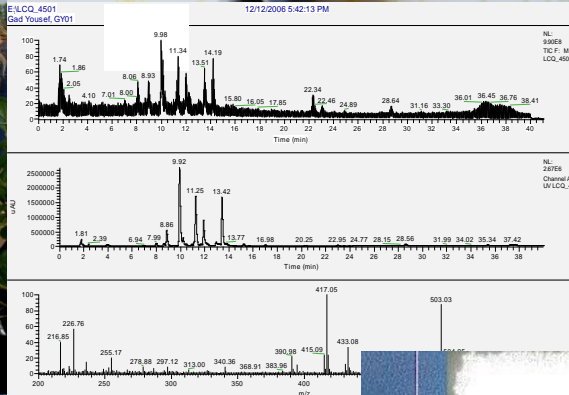
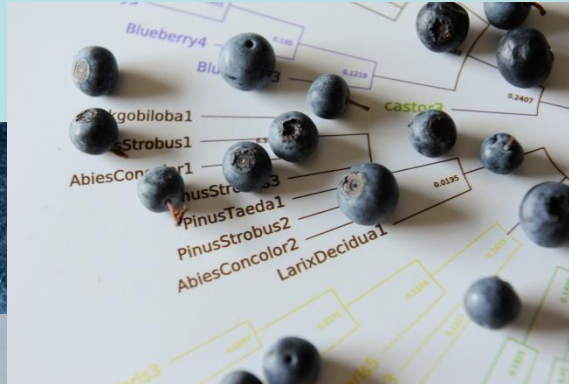


Table 1
¹⁴C label in plasma and brain.

Fraction	Serum AUC (% dose × h)	% Dose in brain	Brain ¹⁴ C/serum AUC
I	1.34	.007%	0.0050
II	0.82	.016%	0.0200
III	1.11	.011%	0.0101
IV	2.07	.125%	0.0605
V	3.46	.119%	0.0343

Characteristics of a Superfruit

Superfruit **NUTRITIVE VALUE**

Superfruit **PHYTOACTIVES** (bioactive compounds)

Superfruit **ORGANOLEPTIC PROPERTIES**

Superfruit **WHOLE FRUIT** (not supplements)

Superfruit **EXOTIC ALLURE**

Superfruit| Science in the Marketplace

Why we eat what we eat

Sensual / physiological reasons

That smells good
That looks good
That tastes good

I'm tired

I'm hungry

Social / emotional reasons

It's my wife's
favorite dish

It's a traditional
dish

I'm depressed

It's my birthday

Unlike plants, we can't
make our own food,
so we must eat; we
are *heterotrophs*



Superfruit| Science in the Marketplace

How consumers decide what to buy (to eat)

Economic reasons



I can't afford to buy fresh fruit



I don't have time to cook – we'll have take out tonight



Media and marketing

It's a superfood



I will be healthier if I take a multivitamin pill



I need to detox

Carbohydrates are bad
Carbohydrates are good



Organic is healthier



The Paleo Diet Solution
Unlock the Secrets of Evolution

Why Superfruits?

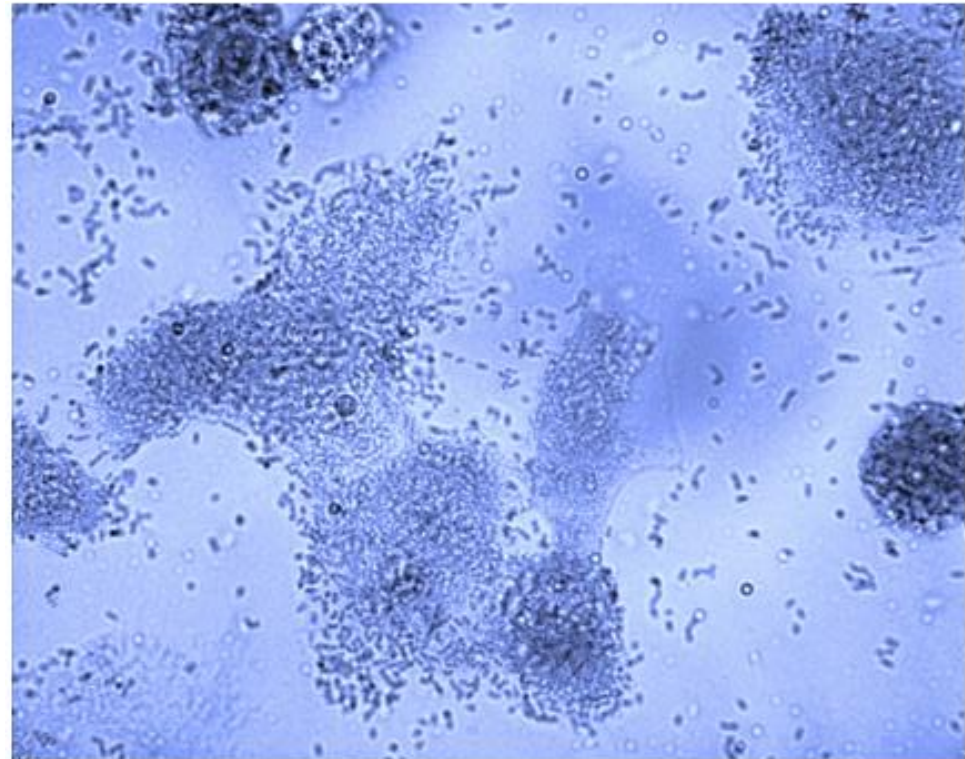




Impact in the Marketplace (who is buying, who is not, and why?)

the hype, the science, & marriage of the two

CASE STUDIES



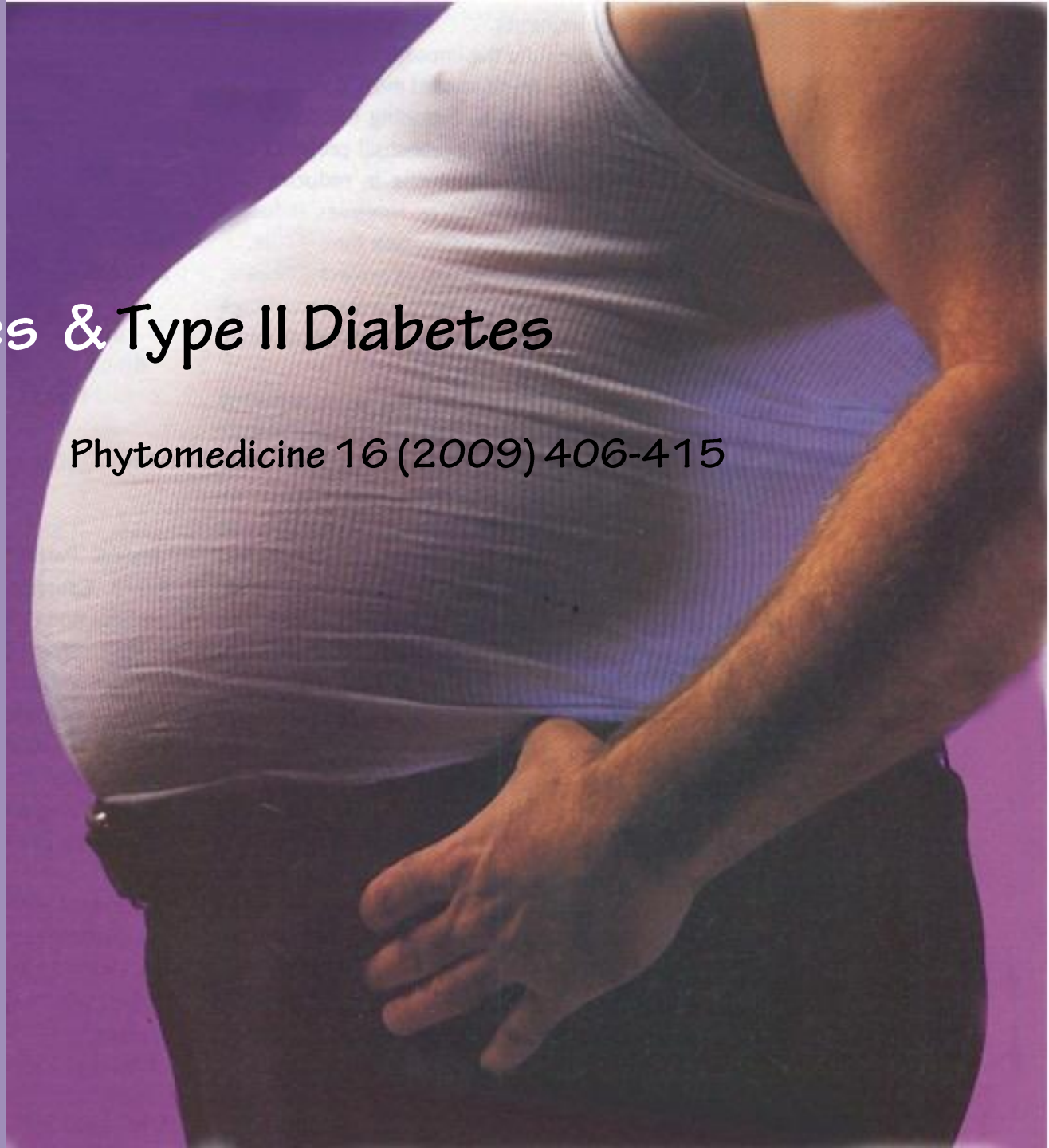


the hype, the science, & marriage of the two



Blueberries & Type II Diabetes

Phytomedicine 16 (2009) 406-415

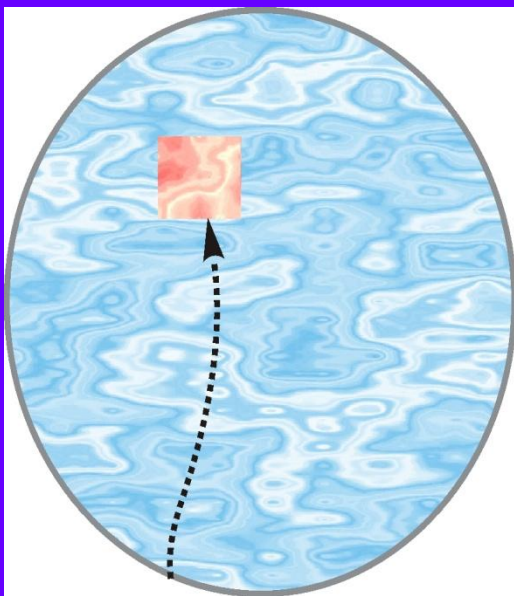
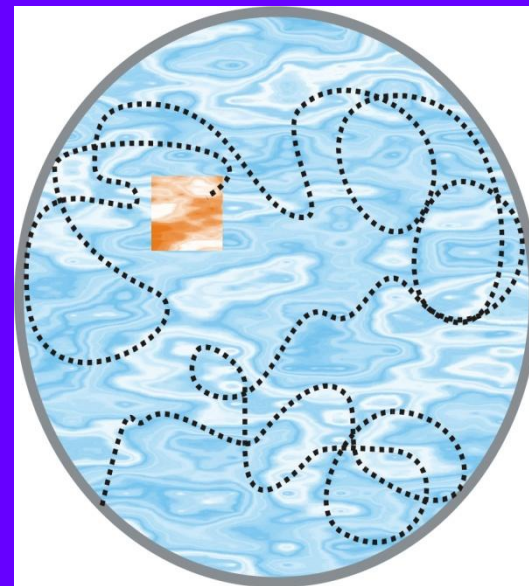
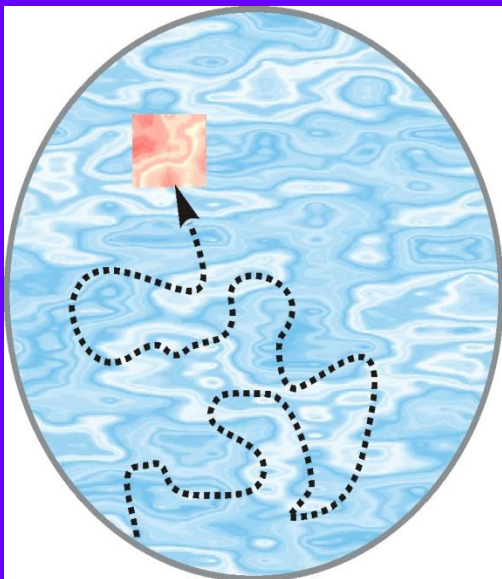


Hyperglycemia (elevated blood glucose) = hallmark of diabetes

Metformin = pharmaceutical anti-diabetic drug;
rapidly lowers high blood sugar levels

Blueberry Anthocyanins have blood glucose lowering capacity





Berries & Gut Health

In vitro pure cultures:

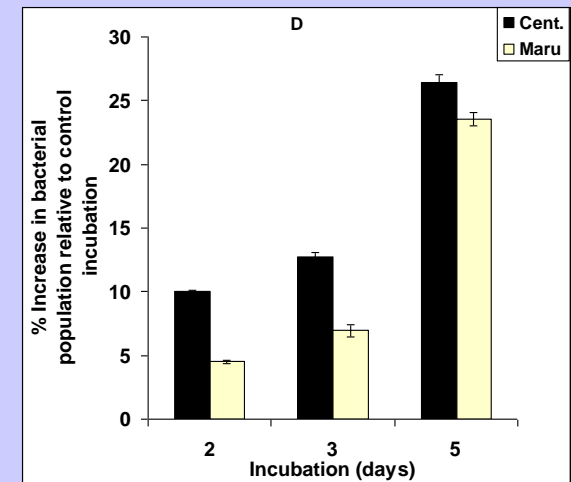
Increase in *Lactobacillus* and *Bifidobacterium* colonies; decrease *E. coli*

In vitro mixed batch cultures:

Increase in *Lactobacillus* and *Bifidobacterium* colonies; decrease *E. coli*

In vivo rat trials:

Increase in *Lactobacillus* and *Bifidobacterium* colonies; decrease *E. coli*





SCIENCE SWAYS THE MARKETPLACE

The Health Story



“From something in a muffin to a health icon”



*We didn't change the blueberry,
we changed the way people think about it*



Breakthrough Health Communications



Food

By DOROTHY FOLTZ GRAY

The Blueberry Breakthrough

Packed with cell-protecting antioxidants, this summer delicacy may just be the first real brain food



Just when summer goes from pleasant to unbearable, along come blueberries. Like open windows and blowing curtains, a handful evokes a long lazy afternoon with nothing to

do but nibble. They're the best to plunk into a bowl of fruit or simply straight off the bush, or now with a little sugar and butter make per dough until the most delectable thing like pulled from a warm oven. So what if they're not here five plus a few or two? The taste is worth the wait.

Actually, the diet obtained from blueberries also may well be the most valuable measure the fruit has to offer. Antioxidants (from the Greek for "dark

blue"), the pigments in blueberries and red crops such as cherries, plums, and red cabbage, are powerful antioxidants, those much heralded chemical warriors against heart disease and cancer. In fact, among 40 fruits and vegetables tested in a recent study, blueberries had the highest antioxidant capacity, primarily because of their large anthocyanin concentration.

How exactly do antioxidants keep us healthy? Our bodies do consume them on the fat and sugar we eat. They get it by burning the fat we take in as fuel, converting it to carbon dioxide and water vapor, both of which we exhale. The energy generated in this oxidation is captured and delivered to our muscles and brain cells, that's what keeps us moving and thinking.

But the whole process of breathing, digesting, and excreting also creates large quantities of unstable molecules called free radicals. Inside your body they're the random burning with a very smoldering time, breaking windows. Some of these more aggressive are cancer. Oxidized cholesterol by free radicals promotes the buildup of plaque in blood vessels, setting the stage for heart disease. Cells repeatedly attacked by the major molecules can mutate and even cancerize.

Young bodies have repair mechanisms that limit these injuries. Fighting diseases weakens an aged man of the same goes unattended. That's where antioxidants come in. They step right between the free radicals and their cellular targets, absorbing the damage themselves. The strength did more numerous antioxidants, the greater the protection of "burners" at bay.

Over the past decade more and more studies have shown that the powerful antioxidants in red wine cut down the oxidation of LDL (cholesterol), possibly helping to fend off heart attacks. And blueberries' antioxidants seem to have the potential to prevent cancer. In a 1998 study at the University of Illinois at Urbana-Champaign, scientists fed several breeds, including the wild blueberry and the following blue small European blueberries, the active of an enzyme that speeds cell division, breaking a link in the chain of events that can lead to cancer.

A more recent study suggests that antioxidants protect not only heart and body tissue but that of the

The Miracle Berry

Want to stop aging, live longer, and keep your mind sharp? Make BLUEBERRIES a habit!



by Holly McGord, RD
Photography by Hilmar

If you add one food to your diet this year, make it blueberries. Colors for color is, however, blueberries have recently emerged as the single most nutritious food in the supermarket at halting the forces that age you. Even the scientists who study blueberries are excited.

Radical Resistance

Every second of your life, your cells are bombarded by dangerous particles called free radicals. In a split second, they can alter your DNA in ways that cause cancer. Or change LDL cholesterol (the bad cholesterol) so it sticks to artery walls. Or damage collagen and make skin wrinkle-prone. Over time, changes such as these accelerate your aging.

Fortunately, you can fight back. The trick is to load your diet with antioxidants—the natural support of free radicals—by eating lots of fruits and vegetables. And that's



SWARDLICK
MARKETING GROUP

Breakthrough Health Communications



Garlic

Oh, that stinky smell! What if your garlic—and your health—could be both as powerful as it is healthy? The new research suggests that garlic could help prevent heart disease, cancer, and other chronic diseases. It's not just the smell that's so powerful, it's the garlic itself. The garlic bulb is packed with compounds that can help prevent heart disease, cancer, and other chronic diseases. It's not just the smell that's so powerful, it's the garlic itself. The garlic bulb is packed with compounds that can help prevent heart disease, cancer, and other chronic diseases.

Green Tea

It's the perfect drink for staying healthy. Green tea is packed with antioxidants that can help prevent heart disease, cancer, and other chronic diseases. It's not just the taste that's so powerful, it's the green tea itself. The green tea leaf is packed with compounds that can help prevent heart disease, cancer, and other chronic diseases.

Blueberries

For the past few years, blueberries have been hailed as a superfood. They're packed with antioxidants that can help prevent heart disease, cancer, and other chronic diseases. It's not just the taste that's so powerful, it's the blueberries themselves. The blueberry fruit is packed with compounds that can help prevent heart disease, cancer, and other chronic diseases.

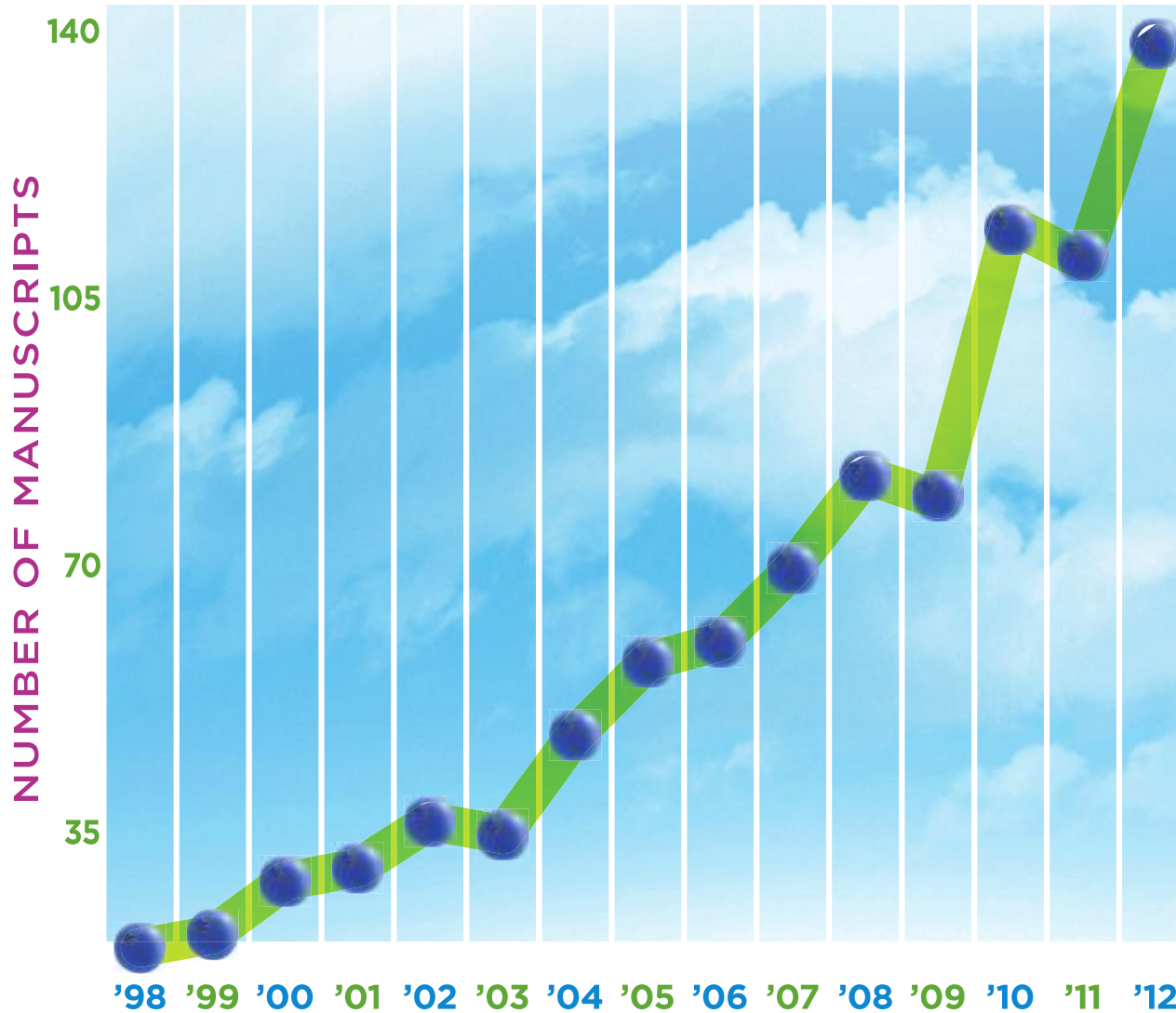
Science impacts the marketplace

- Scienceand the trickle-down effect



Blueberry Research Gone Wild!

BLUEBERRY/BILBERRY PUBLISHED HEALTH STUDIES



NORTH AMERICAN BLUEBERRY CONSUMPTION

With blueberry production increasing to match rising levels of consumption, it's clear that more Americans are discovering just how good these Little Blue Dynamos are.!


Total

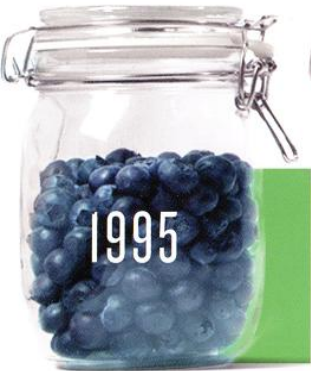
853
million lbs.

749
million lbs.

283
million lbs.

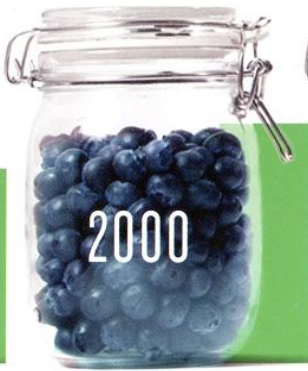
349
million lbs.

414
million lbs.

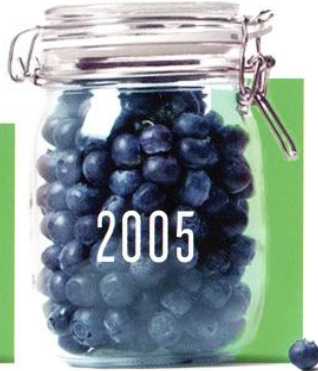


15.5 oz.

Per Capita



17.8 oz.



20.2 oz.

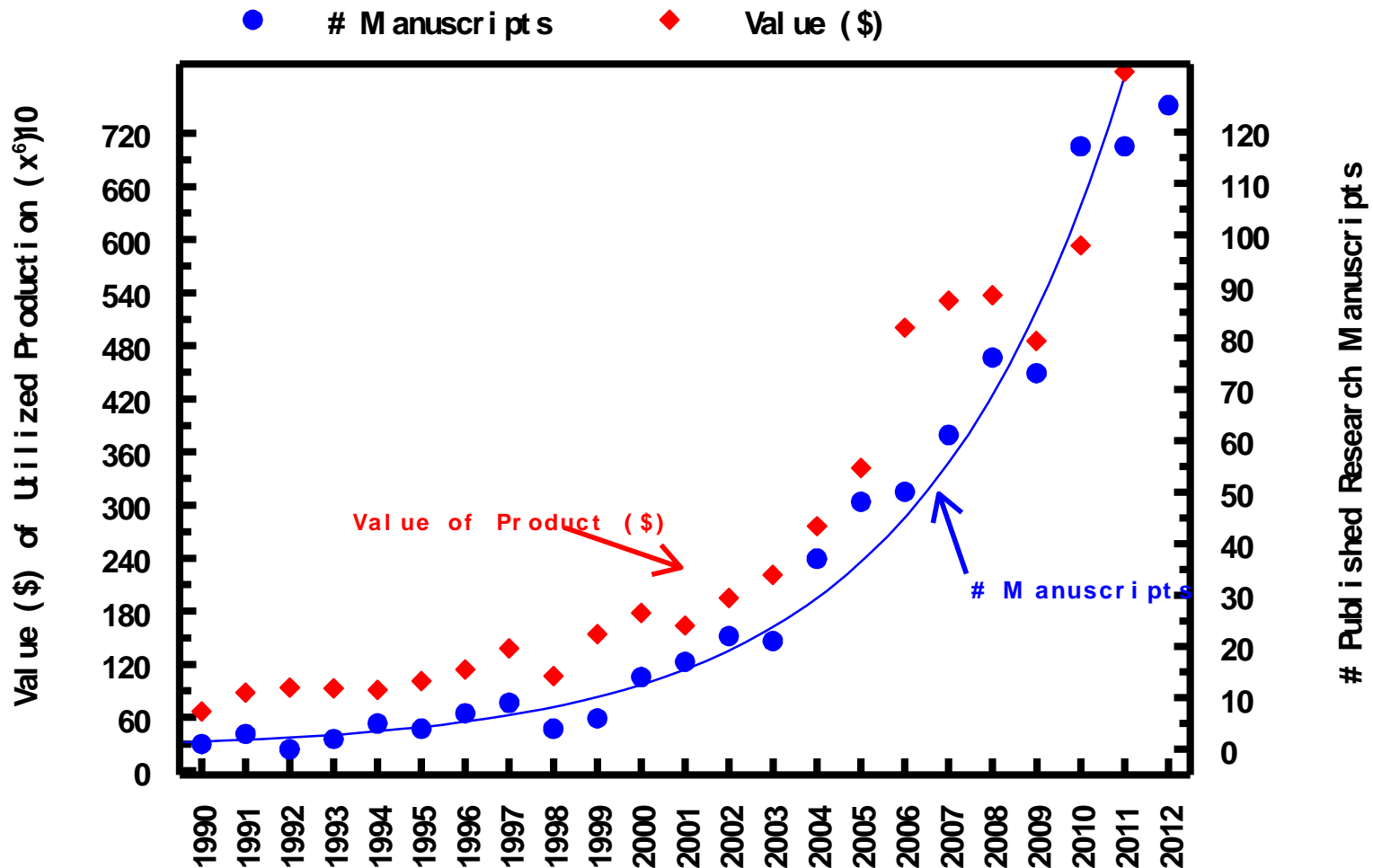


34.9 oz.



39.5 oz.

Impact of Science Communications on Product Value (Blueberries)



Sources: USDA, ERS, May 2012

Pubmed/EBSCO searches by R. Prior, 2012



Influence of a blueberry-enriched protein powder on exercise-induced inflammation and oxidative stress in athletes: Metabolomics Approach



ASU-NCRC HUMAN PERFORMANCE LABORATORY

Trained distance runners.
Blueberry & green tea
& protein treatments.



Competitive long-distance runners ran for 2.5 h/d on treadmills at $\sim 70\% \text{VO}_{2\text{max}}$ for 3 d in a row.

This was an intensified period of exercise for these runners, inducing “overreaching”.



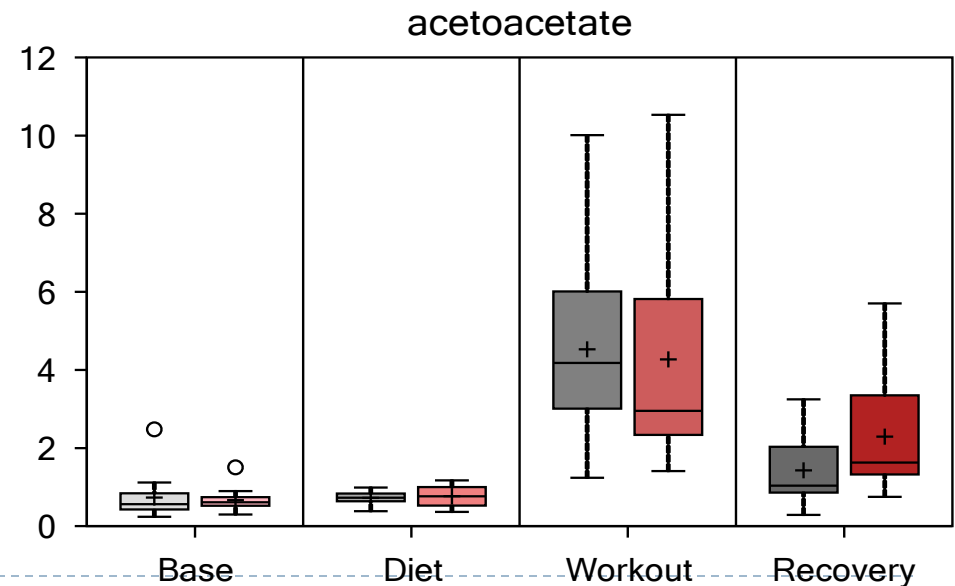
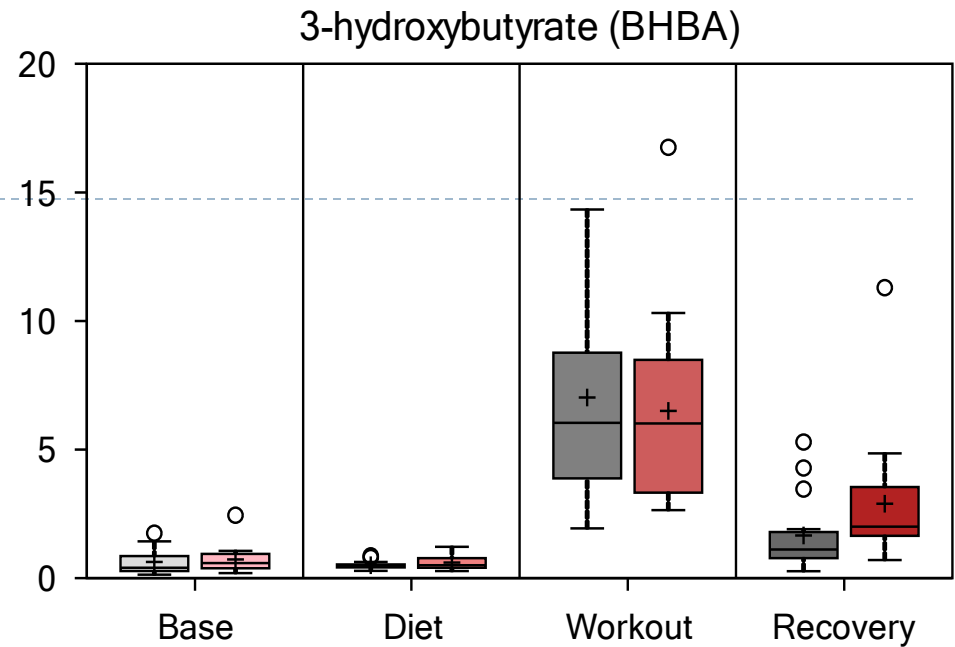
Runners supplemented with the blueberry/green tea protein supplement continued to utilize fatty acids during recovery (14 h post exercise).

- ▶ Fatty acid oxidation and ketogenesis were strongly induced by exercise in both groups, with elevations in ketones more evident at 14-h recovery in the treatment group ($P < 0.05$).

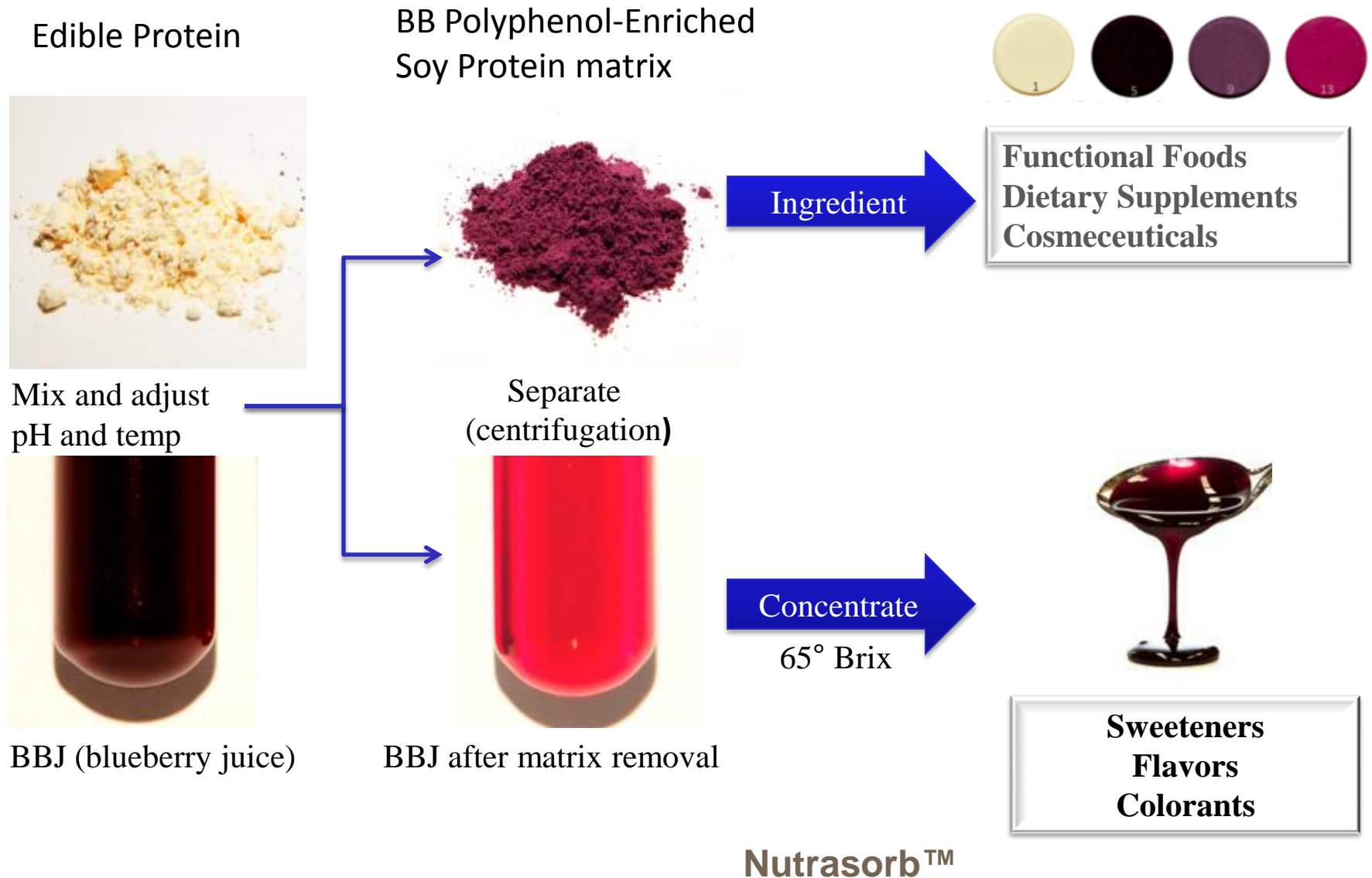


PolyPhenolics Supplement Increases Ketogenesis and Fat Oxidation During 14-h Recovery

- Treatment was linked to enhanced ketogenesis throughout 14-h recovery.
- This indicates enhanced fat oxidation.



Superfruits Seasonal Gluts & Waste



Nutrasorb-Zambia

Funded by Bill & Melinda Gates Foundation
Grand Challenges Explorations

Goals of Phase I: Develop and validate an innovative, portable and stable protein-rich food ingredient fortified with bioactives from local fruits

Targeted Population: Children and pregnant and nursing mothers



Close to 45% of Zambian Children Experience Hidden Hunger or Malnutrition



Zambian Infant Mortality Rate is 65/1,000 live births (23/222)





Ground Nut (Peanut) is the Main Source of Protein





Full Fat Soy Cake (Before)



Spread into Thin Layer



Juice-Flour
3:1

Juice-Flour
2:1

Dried in Vacuum Oven



Mango-flour paste
inside the oven



After 4 hours of
drying at 45°C



Dried flakes



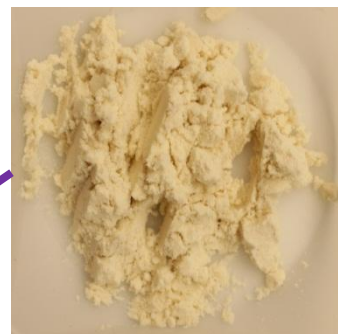
Ground powder

NS-S (Sorption) for Muscadine Juice

- **Efficient, One-Step, Sorption of the Medium Polarity Polyphenolic Compounds**
(Polyphenolic Compounds are Sorbed and Stabilized by Protein-Rich Matrix)
 - **Does Not Sorb Unwanted/Non-Nutritional Material**
(Sugars, Pectin, and Excess Water are Removed with the Supernatant)

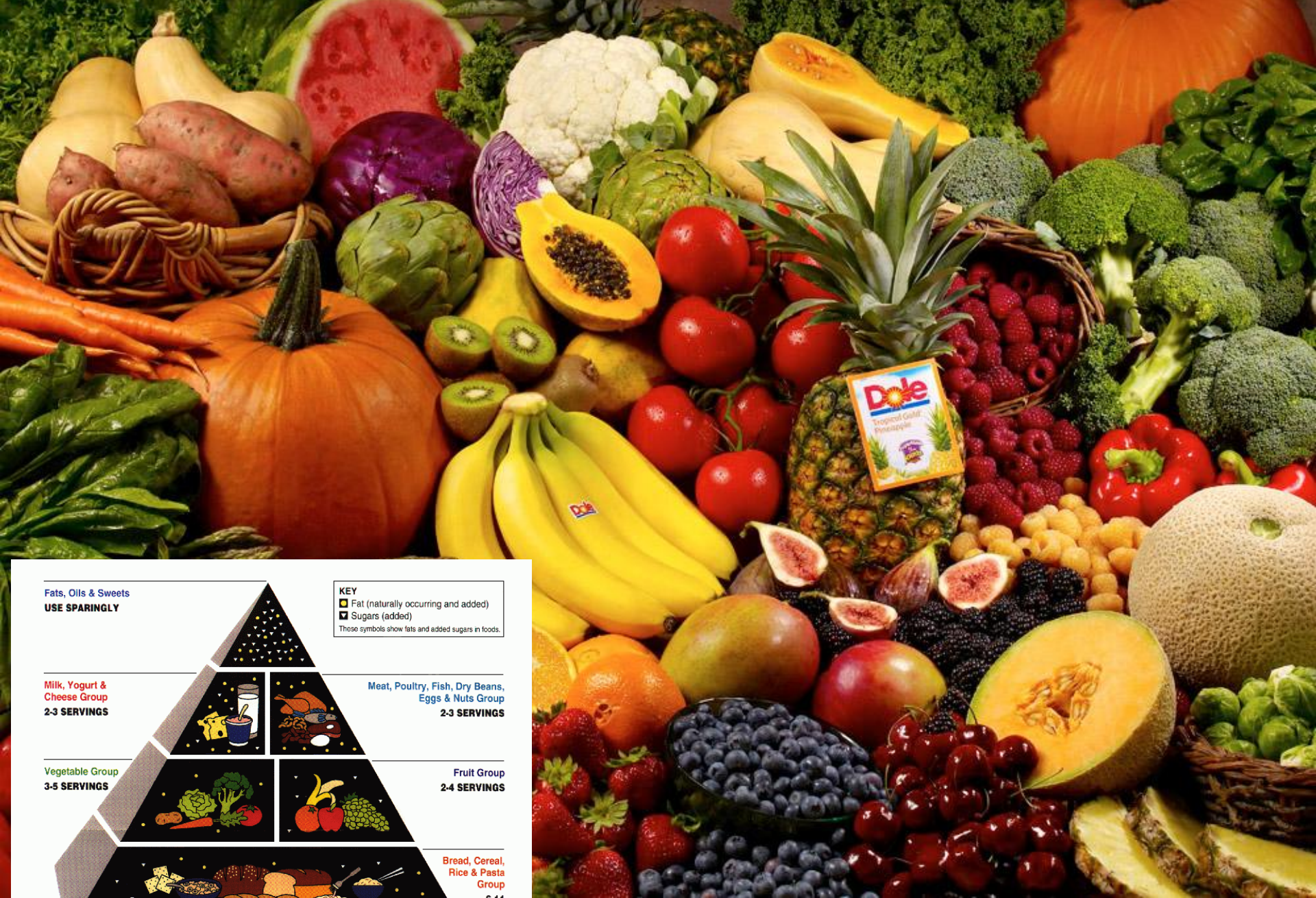


Hemp Flour w/50% Protein
(HP50)



ADM Soy Protein Isolate
(SPI)





Fats, Oils & Sweets
USE SPARINGLY

KEY

- Fat (naturally occurring and added)
- Sugars (added)

These symbols show fats and added sugars in foods.

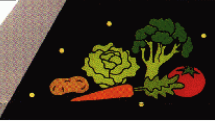
Milk, Yogurt & Cheese Group
2-3 SERVINGS



Meat, Poultry, Fish, Dry Beans, Eggs & Nuts Group
2-3 SERVINGS



Vegetable Group
3-5 SERVINGS



Fruit Group
2-4 SERVINGS

Bread, Cereal, Rice & Pasta Group
6-11 SERVINGS

